

September 15, 2006

Cheryl Niemi
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504

RE: Draft Economic Guidance for Meeting Water Quality Standards for Dams

Dear Ms. Niemi;

Our organizations submit these comments on the Washington Department of Ecology's (Ecology) "Guidance for Evaluating the Feasibility of Controls to Meet Water Quality Standards for Dams in Washington," circulated on August 3, 2006. We appreciate your extensive effort to hear our interests. It is our understanding that Ecology will be preparing another draft with substantial changes from this version. We request that Ecology provide an additional comment period and a red-lined document or a summary of major changes that were made from the previous version.

We submit the following general comments followed by specific comments:

General Comments

Funding

To make this guidance meaningful, with anticipated 10-year compliance schedules and the resource-intensive economic feasibility process that Ecology has designed here, Ecology must provide adequate funding for any of its relevant programs. For example, the program we are most familiar with, the Clean Water Act Section 401 water quality certification (401) program for hydropower dams, receives only minimal direct funding for its important work. The additional work burden proposed here will exacerbate that program's existing resource limitations. With several licensing processes on the horizon and present licensings requiring continued oversight, Ecology must find a way to fund proper staff levels to match the expanding future workload.

Focus

We have worked with Ecology as the focus of the guidance changed from Use Attainability Analyses (UAA) to dam compliance schedules, presumably out of greater need for the latter. Ecology states that the guidance will still be used to inform UAA processes.¹ It is not clear what "inform" means particularly given the significant difference between the two processes. Will Ecology rely on the information collected in

¹ The guidance says that "this guidance will be used to inform decisions on how to proceed with that [UAA] analysis." It is unclear which UAA provision the guidance is referencing. Both 40 C.F.R. § 131.10 (g)(6) (Special Notes to Reviewers, Guidance Introduction at 3) and 40 C.F.R. § 131.10 (g)(4) (Guidance at 1-1) are mentioned.

its economic analysis for a UAA process? Will Ecology adopt a similar approach to assessing economic feasibility? Please clarify this relationship.

To the extent that this guidance will be used to inform UAA decisions, we underscore our original argument that Ecology does not have the legal authority to include economics under the test established in 40 CFR § 131.10 (g)(4). We are also opposed to the guidance's proposed definition of "feasible" bearing any formal relationship to the "feasible" test for UAAs. If Ecology is defining feasible here, or at least determining what subjects generally constitute feasible, it must not carry that definition or determination into its UAA process. We request a statement in the guidance that any feasible test proposed in this document related to dam compliance schedules has no bearing on the appropriate feasible test pursuant to the federal UAA regulations.

Even with the changed focus, our baseline concern remains: water quality will be degraded. This degradation is the effect of using economic factors to make decisions about whether water quality standards will be met, leading to inequitable treatment among streams and among dam owners. Dam owners who operate their facility poorly or who have a marginally beneficial facility will have an easier time acquiring Ecology's determination that they cannot meet water quality standards. Any economic test should not privilege these marginal dams. The inequity among dam owners will lead to inequitable treatment among the streams under Ecology's charge. Under such a scenario, a stream with a marginal dam will receive less protection than other dammed streams simply because of the financial capacity of the dam's owner.²

Legal

In reviewing this draft guidance, our organizations still have several fundamental legal concerns that the guidance does not alleviate.

First, we question the legality of considering certain economic factors in ascertaining whether water quality standards will be met. Ecology has not provided any legal rationale for the role of economics within the Clean Water Act framework. At minimum, Ecology must justify including a financial test in its analysis of alternatives to meet water quality standards.

A recent decision in the D.C. Circuit Court of Appeals specifically rejects a financial test under another dam-regulating statute, the Federal Power Act. In this decision, the court rejected the utility's argument that the Federal Energy Regulatory Commission (FERC) could not require critical environmental measures if those measures rendered the project uneconomic. Instead, the court found that it is within the definition of *reasonable* to require environmental measures that make project economics unfavorable. The court asserted:

² The guidance acknowledges many of our concerns in the Guidance text box at 5-9, including misallocation, passing costs and burdens to others, and the problems with permitting marginally beneficial or negative profitability producers to continue to operate dams. Yet, Ecology does not meaningfully incorporate these good ideas into its economic analysis.

The question we must decide is whether ‘reasonable terms’ can, in some cases, be terms that may have the effect of shutting a project down or occasioning a change of ownership. We think the answer is yes.

City of Tacoma v. F.E.R.C., --- F.3d ----, 2006 WL 2411362 (D.C. Cir. 2006) (hereinafter referred to as “the Cushman decision”)

The Cushman decision is clear that FERC may issue a license with *reasonable* terms which cause economic hardship. Under the logic of the Cushman decision, one could argue that “reasonable and feasible” in a dam compliance schedule should not include an ability-to-pay analysis.³ We recommend that Ecology adopt the position that alternatives to meet water quality standards are “reasonable and feasible” regardless of financial hardship, as validated under another statute by a court of law.

Second, documents distributed at one of the public hearings to discuss the guidance indicate that Ecology is proposing to issue Section 401 water quality certifications incorporating dam compliance schedules for water quality standards that will not be met.⁴ This action conflicts with the terms of Section 401, which require “reasonable assurance” that water quality standards will be met.⁵ We are opposed to any suggestion that a 401 can be issued without reasonable assurance that the standards will be met. If water quality standards will not be met, then Ecology simply cannot issue a 401 certificate. Ecology must write guidance that is legally defensible, and cannot publish a document that suggests decisions or actions that are not permitted under the Clean Water Act.

Specific Comments

Many significant issues areas remain unresolved, and lacking definition, it is difficult to understand the consequences of a decision or think creatively about another way to design the process. For this reason, Ecology must publish another draft for public comment and review. We outline several general issues below.

Dams Covered by the Guidance

For what dams is this guidance applicable? Ecology’s descriptions in the guidance are inconsistent and conflicting. Ecology writes that the guidance is potentially applicable to “dams and other hydrologic modification projects;” “existing hydroelectricity generating facilities, but can be adapted to address other types of dams;” “dams and other large hydrologic modification projects;” and “large hydropower producers and other dams.”⁶

³ WAC 173-201A-510(5)(ii) states: “Identification of all reasonable and feasible improvements that could be used to meet standards, or if meeting the standards is not attainable, then to achieve the highest attainable level of improvement.”

⁴ See flowchart distributed at Lacey meeting, August 25, 2006. “Cniemi draft 7/26/06. Draft: Implementing the dam compliance schedule (WAC 173-201A-510(5) for 401 certifications.”

⁵ 33 U.S.C. § 1341.

⁶ See Guidance Introduction at 1 and 2.

The next draft guidance must include a concise and clear description of which dams are covered by the guidance.⁷ If Ecology intends to limit the guidance to dams of a specific size, such as “large”, it must specifically define them. Does “large” apply to power production, the scale of the project’s impacts to the natural environment, or the height of a dam? What is the threshold between “large” and “not large?” If Ecology excludes dams by ownership, power production, or size, please explain why. For example, if the guidance applies to federal hydropower dams, why does it not apply to federal dams that do not have hydropower facilities?

Timeframe

It is not clear when this proposed analysis will take place or how it relates to other critical water quality processes. The process that Ecology describes has no specified place in the 401 or TMDL process, compliance schedule, or other federal regulatory timeframe. Without that center piece, we cannot undertake a thoughtful critique.

Ecology must describe a proposal in depth with the process initiation trigger and a specific process schedule. The process should be a distinct process with a beginning, end, and phases in between, not spread loosely over time. If Ecology integrates the economic feasibility determination into the 401 process, it must do so in a way that reflects the legal limitations of 401.

We request that the issue of timing be specifically clarified in the next draft and include a detailed timeline of how this guidance would be implemented to a specific project.

Public Process

Ecology has requested input on a potential public process. Given the lack of information regarding when this analysis takes place or how it relates to other regulatory processes, it is difficult to do more than emphasize that there must be a companion public process.

When preparing a 401 certification, Ecology offers notice and comment on the application and on a draft 401 certification. A public record is maintained. Similar features should be in place in an economic feasibility determination. For a dam compliance schedule pursuant to a 401 certification, all license parties – that is, stakeholders who have formally intervened in the FERC licensing proceeding, identified on FERC’s service list – should be contacted.

Ecology must issue a public document that provides all alternatives considered and the basis for any determinations. The public must be able to review all economic information relied upon for a decision and a responsiveness summary. We understand that Ecology may not want to release confidential business information, but we appreciate its inclination to release information unless otherwise specifically directed.⁸ Without a sense of when the process occurs, we cannot offer more specific advice on how to design a public process.

⁷ It is critical to note that Ecology’s regulations do not apply to hydrologic modifications. Accordingly, neither should this guidance.

⁸ See 1.2 Confidentiality, Guidance at 1-2.

Financial Scope

Ecology is not consistent with its description of the financial scope of the analysis. At several points in the guidance, Ecology refers to “the dam.” The dam’s economics are not at issue; rather it is the economics of the dam owner that are under investigation. Ecology should revise to make clear that the financial feasibility test is related only to the dam owner and not limited to the project. For some dam owners, namely IOUs, the scope will expand beyond the dam owner to parent companies.

Terminology

Ecology uses the word “application” throughout, but this or any other term indicating a submittal is inappropriate. Ecology has not yet identified that there will be an application, or that there will be a point at which a dam owner must submit a defined set of materials for review. It is not clear that there will be an application in any future defined process, particularly since Ecology envisions an “ongoing collaborative process.” See Guidance at 2-2. Please eliminate this word choice or explain when and how an application would exist.

Ecology also uses the term “economic feasibility test” inconsistently. On one hand, Ecology says that economic feasibility is a two-part test: the first step is an ability-to-pay analysis, and the second step is the socioeconomic analysis. See Guidance at 1-1. On the other hand, Ecology indicates that an economic feasibility test is a financial feasibility test, and that the socioeconomic step is separate. See Guidance at 2-4 and Section 1.4. Please clarify which tests “economic feasibility” is referring to, and apply the term consistently.

Definition of Reasonable and Feasible

Ecology’s guidance document arbitrarily assigns whole subject areas to either *reasonable* or *feasible*. There is no provided or ascertainable reason for placing a subject area in one category or excluding it from another. Please provide a rationale for breaking down reasonable and feasible into individual definitions, for including a subject in one definition or another, and for changing the position of a subject from this draft guidance to the next draft guidance.

Cost of Process

Ecology acknowledges a concern that the cost of going through the economic feasibility process in itself may be too costly to dam owners.⁹ While we agree that needless expenditures are in no one’s best interest, we caution against any effort to streamline the process. We do not see how streamlining can take place without some expense to the environment. As Ecology says, a comprehensive and credible analysis is required in order to determine whether water quality standards can be met. The economic feasibility test ought to be a rigorous one.

⁹ See Guidance Introduction at 5.

Second Compliance Schedule

Ecology suggests that if water quality standards are not met within a 10-year dam compliance schedule, the next appropriate step is to issue a second compliance schedule.¹⁰ Under this step, compliance schedules are effectively 20 years long – that is, potentially 20 years without meeting water quality standards. We are not convinced that the automatic next step after failing to meet water quality standards in a 10-year period is another 10 years to attempt to meet water quality standards. We request that Ecology remove any indication that a second dam compliance schedule is automatic.

Selection among Alternatives

Ecology may make a determination that water quality standards can be met and recommend an alternative. According to the guidance, Ecology will recommend the least-cost alternative rather than the alternative that best meets Ecology's objectives. In the feasibility process, dam owners are asked to rank alternatives by cost. If there are five potential measures that meet water quality standards, Ecology indicates that it will select the measure that is least expensive.¹¹

There are a number of other concerns aside from cost that Ecology must factor. Ecology must weigh whether the technology is tested, likely to last over time, suited for this dam, these resources, and this river. Dam owners may suggest technologies that have limited applicability, but cost far less and minimally accomplish the job. Ecology is well within its authority to consider the durability and credibility of proposed measures and the lack of these aspects for other measures. At all instances cited above, the guidance should be revised to reflect the multiple considerations for selecting an alternative.

Similar to the National Environmental Policy Act (NEPA), Ecology should compel all alternatives considered and rejected to be submitted for their approval and the public record. Ecology and others may not agree with a dam owner's rejection, and a rejected alternative may ultimately be the best to use. The approach is similar to NEPA, where rejected alternatives are described and a rationale is provided for their rejection.

Assessing the Cost of an Alternative

When Ecology assesses the cost of an alternative, it advises: "Note that the cost of an alternative may include environmental studies or mitigations that must be carried out

¹⁰ See flowchart distributed at Lacey meeting, August 25, 2006. "Cniemi draft 7/26/06. Draft: Implementing the dam compliance schedule (WAC 173-201A-510(5) for 401 certifications."

¹¹ "The least cost CEA approach will be used when more than one technology has been identified that can attain the WQS at 100%, and the applicant has to determine which of these technologies provides the least cost approach to achieve the 100% WQS attainment." Guidance at. 1-3; "Applicant has considered the most likely and least-cost available technologies that could be implemented in order to attain the WQS."

Guidance at. 2-1; "The applicant should always submit the lowest-cost technologically feasible alternative that would result in 100% or partial attainment (i.e., the most cost-effective alternative)." Guidance at. 2-2; "Ecology will evaluate whether options other than those presented by the applicant are available and could attain standards or the same level of water quality at a lower cost." Guidance at 2-2; "Applicant should present the most cost-effective option. For alternatives for which economics feasibility is a concern Ecology will evaluate whether options other than those presented by the applicant could attain standards or the same level of water quality at a lower cost..." Guidance at. 3-1.

along with the project.” *See* Guidance at 3-2 Please define the difference between “the project” and “mitigations” as described above. We do not understand what is meant by “mitigations” if not the project itself. With regard to studies as referenced in the above sentence, we believe that the dam owner should be responsible for the costs of studying an alternative.

We agree with Ecology that foregone revenues should not be included in the financial feasibility analysis. We also agree that long-term contracts alone are not sufficient to determine financial infeasibility. *See* Guidance at 3-2 and 3-3. For similar reasons as for foregone revenues, Ecology should not factor in the cost of replacement power under long-term contracts, load requirements, or any other power-related obligation. These costs are considerably variable depending on the type of power, the origin of the power, and market changes over time. Ecology should amend the guidance to remove the statement that the dam owner should “add the costs of alternative methods that could be used to meet the terms of the contract.”

We agree that a dynamic approach to assessing costs is required. *See* Guidance at 4-8. We wholly agree with Ecology’s concern about “concluding financial impacts based on short term conditions that are likely to be mitigated by future economic growth.”

Once the costs to the dam owners of various alternatives are identified, an unanswered question in this guidance is: how will Ecology decide that the dam owner cannot pay? The guidance discusses information collection and subjects to be discussed, but – when is the financial impact too great? Although not part of the determination of whether a dam owner can pay, the guidance document similarly leaves vague when the socioeconomic impacts are unacceptable. The guidance must discuss these issues, rather than avoid them.

Appropriate Cost

In the initial section – “Appropriate Cost” – Ecology proposes not to add any additional detail about how or whether to answer the question, “is it worth it?”¹² If Ecology decides to include a discussion of the issue in the document, despite its irrelevance to the questions at hand, Ecology must address several issues. How will Ecology proportionalize resource benefits and dollars? Will it attempt to quantify the economic benefits of resource protection and evaluate that number against the cost of the measure? How will Ecology know what is a “no-brainer”? Will there be a “no-brainer” because the benefit of meeting water quality standards is too great?

Although Ecology is not proposing to adopt this approach here, both public statements and the discussion within this guidance indicate that Ecology will consider using this approach. Without clarification of the above-mentioned issues, our organizations cannot support this approach. As such, we request that the limited proportionality discussion be struck.

¹² *See* Guidance Introduction at 4.

We do not believe that the Clean Water Act permits us to ask whether meeting water quality standards is “worth it.” Practically, disproportionality ignores the cost of a measure, no matter how small, and attempts to monetize meeting water quality standards – an analysis in which the resource will lose. Disproportionality also lets us rationalize that the proportion is too disparate regardless of the ease of meeting standards. If a measure is affordable but, in the dam owner’s mind, “not worth it” because there is no impact to the resource, then the owner should plead its case with a site-specific criteria request, variance, UAA application, or pursue another process to change water quality standards.

Cumulative Impacts

How will Ecology apportion responsibility to address cumulative impacts? The industry has argued that a dam owner can only be responsible for its dam’s contribution to the violation of water quality standards. However, how, if at all, will cumulative impacts to water quality be addressed?

Further, why should water quality standards be considered unreachable when an upstream facility could take actions to help meet the standard? For example, an upstream facility significantly warms a stream to a point that barely meets standards. The upstream facility received a 50-year license in 1971 from FERC; yet a downstream facility is currently in relicensing and must obtain a 401 certification. While we agree that the burden of addressing that water quality issue should not wholly fall on that downstream facility, Ecology should utilize its regulatory tools to address the upstream facility prior to making a final decision on the downstream facility. Ultimately, Ecology cannot design a system that will put the entire burden on downstream users or that will allow the downstream user “off-the-hook” without addressing upstream facilities’ contribution to a violation.

Policy

In several places in the guidance document, Ecology generally mentions policies that inform the guidance, but fails to provide discussion of these policies and how they apply.¹³ Please explain which policies are referenced, or describe in greater detail the considerations Ecology believes would belong in such a policy.

Socioeconomics

The document provides conflicting statements regarding the standard that must be met under the socioeconomic test. In one place, Ecology indicates that its standard for the socioeconomic test is “no adverse impacts.”¹⁴ That is not the standard. If it were, one cent per year in rate hikes would trigger the standard. As stated later in the document, the standard is “significant adverse impacts.” See Guidance at 8-2. Please correct the guidance to be consistent.

¹³ See “a socioeconomic policy perspective,” Guidance at 2-4; and “from a policy perspective,” Guidance at 2-3.

¹⁴ See “to ensure that there are no adverse impacts on the local area,” Guidance at 7-1; and “Ecology requests a socioeconomic analysis to verify that the project would not result in adverse impacts on the broader community,” Guidance at 8-1.

Ecology duplicates considerations by defining the geographic area as a community of households and businesses. *See* Guidance at 8-1. This community's concerns should only be considered, if at all, as part of an overall socioeconomic test, not specifically to the financial feasibility test.

Ecology also does not acknowledge the direct and indirect benefits to businesses and communities of meeting water quality standards. For some industries, such as recreation, travel, tribal businesses, or commercial fishing, the benefits are straightforward. Other businesses rely on a quality of life that water quality may support, such as a pleasant aesthetic setting, outdoor opportunities, and safe or healthy play environments for children. Communities certainly benefit from a higher quality of life. Although Ecology generally includes "potential positive" impacts of requiring a measure in its socioeconomic analysis, the guidance de-emphasizes this concept and does not expand upon it. *See* Guidance at 2-3. The socioeconomic test must incorporate the benefits of meeting water quality standards, and the losses to these communities and businesses if water quality standards are not met.

Determination

As stated earlier, any determination should be a public document that provides all alternatives considered and the basis for the final determination.

Upon determining that water quality standards cannot be met, Ecology must issue a formal determination that can be appealed to the Pollution Control Hearings Board. The determination must include a statement effectively authorizing non-compliance with water quality standards, and must establish a schedule requiring the dam owner to pursue a standards change within a short timeframe. The schedule should also specifically provide that failure to adhere to the schedule will result in unauthorized violation of water quality standards subject to fine or other penalty.

Ecology has expressly stated that its process for determining economic infeasibility is less stringent than that required for UAA under the (g)(6) provision. Ecology must explain how it will address a situation where no reasonable and feasible alternatives exist, yet the requirements in any standards change process will not be met. What will Ecology do for the dams that reach the regulatory limbo of meeting an economic infeasibility test, but then failing to pass the standards change? Ecology must propose an action to resolve the incongruity.

Review of Guidance by Jon Goldstein

Finally, we attach the comments of Jon Goldstein of GTBE Economics, who conducted a review of this guidance document. We wish to reiterate several of his points here, discussed in greater depth in his critique.

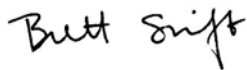
- § We share the concern that if other power generators have to pay for the cost of mitigation, why relieve hydropower facility operators? Hydropower then has an unfair advantage over other power sources.

- § The attached critique also points out that mitigation is not the last resource which a company has to purchase. All optional and mandatory costs should be examined, not just the additional costs of mitigation.
- § Ecology does not design an ability-to-pay analysis for the federal dam owners, making it unclear what Ecology is proposing to do about these facilities.¹⁵ We cannot provide comments without additional information.
- § Ecology's test fails to weigh the benefits and the economic value of water quality improvements, and does not consider the potential economic loss from failure to meet the standards.

Mr. Goldstein has also proposed several new ideas, which we have not had adequate time to review and require more thought before our organizations can support them. We do, however, offer his entire critique and suggestions, for your benefit.

Please contact us with questions about our comments.

Respectfully submitted,



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Rick Eichstaedt
Center for Justice
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¹⁵ “[A] federal dam owner/operator does not have to demonstrate that it cannot afford to pay for the WQS project....” Guidance at 6-1.

Analysis of the Feasibility Conditions
Proposed by the
Washington State Department of Ecology
for Determining whether
Dams Need to Meet Water Quality Standards

a report to

American Rivers

prepared by

Jon H. Goldstein
GTBEconomics

September 10, 2006

Analysis of the Feasibility Conditions for Determining whether Dams Need to Meet Water Quality Standards

Pursuant to WAC 173-201A-510, the Washington Department of Ecology (hereinafter “Ecology”) has proposed an economic/financial feasibility test to determine what alternatives a dam owner must implement pursuant to a dam compliance schedule. Ecology establishes a two-part test.

- § Can the responsible party (the dam owner) afford the costs (i.e., undertake the mitigation project without being substantially weakened financially),¹ and if so,
- § Can the project be implemented without substantial socioeconomic disruption to the service region and any related geographic area? (In truth, Ecology’s regional economic standard is considerably more demanding than this: “...ensure that there are *no adverse impacts* on the local area.”²)

The first part – a financial feasibility or ability-to-pay test – focuses on the dam owner, while the second part – a socioeconomic test – focuses on a wider range of impacts to parties other than the dam owner. This report contains a critique of Ecology’s proposed two-part test. The first section of this report analyzes the allocative implications of Ecology’s proposed economic feasibility test. The second section of the report critiques the proposed financial feasibility conditions set forth in Chapters 4 to 6 to inform a determination of whether a dam owner can pay for necessary water quality measures. The third section evaluates Ecology’s proposed socioeconomic test.

I. The Economic Implications of Ecology’s Feasibility Test

A. The Allocative Aspects of Ecology’s Feasibility Test

Every economic system has to answer three fundamental questions:

- § What should we make with our limited resources? (Choice)
- § How do we make these commodities as cheaply as possible? (Efficiency)
- § Who gets the products once they are made? (Distribution)

A market system is a procedure for organizing an economy to answer these questions. It results in signals being generated (prices for products and costs for resources) which, under most circumstances, answer these three fundamental questions in such a way that the goods that people want are produced as cheaply as possible, and wind up in the hands of those who value them most. All this happens automatically, without central direction; a remarkable achievement.

Of course, there are certain products for which the system fails, and cannot answer these fundamental questions correctly. We call these products non-market commodities, and a healthy environment is one such product. Further, we have learned that often, if we tweak the system

¹ Guidance Document, p. 4, section 4; p. 1-3, section 1.4, last paragraph; and most clearly on p.5-8, last paragraph.

² Guidance Document, p. 7.1, first paragraph (emphasis added).

just a little bit to internalize the non-market costs (e.g., by requiring producers to mitigate damages to the environment), we can get the system to perform about as well for non-market commodities as it does for market commodities.

The procedure being proposed by Ecology for determining whether it is financially feasible for dam operators to meet water quality standards (WQS) or whether the burden on the dam owner's customers is excessive is not such a tweaking. If implemented, this procedure will generate the wrong signals, distort the allocation of resources, and result in every one of the fundamental questions above being answered incorrectly:

§ **Choice:** The wrong goods will be produced: there will be too much electricity and not enough water quality. By granting relief from WQS to some dam operators whose financial condition would be strongly affected by the compliance costs, Ecology will fail to confront these operators with one of the costs of doing business: the cost of complying with State water quality standards in the State's waterways. As a result, the price of electricity will not reflect the cost of all of the resources used in its production, and will be lower than it should be. Faced with this incorrect signal, users of electricity (producers and consumers) will use more of it than they would if the price reflected the true cost of generating hydropower.

Secondly, because water will be more degraded than it should be, producers whose products require higher water quality (e.g., producers of recreation) or the demand for whose products is related to water quality (e.g., those who supply producers of recreation, those who provide goods and services to recreationers, etc.) will produce less than the optimal amount of their products.

§ **Efficiency:** A whole host of things will be made with the wrong combination of resources. Because the price of power will be lower than it should be, producers will use more of it and less of other resources than is optimal. That is, the incentive for them to invest in energy-efficient equipment and processes will be less than it should be.

Further, too much of the electricity that will be produced will be made from hydropower. If dam owners had to internalize the cost of complying with water quality standards, less hydropower would be generated and more power would be made from other fuels and technologies. These other power generators have to pay for the cost of mitigating their environmental damages. Why should we relieve some dam operators from this obligation and subsidize them on the grounds that compliance might cause them to become financially marginal?

Corresponding arguments can be made regarding the inefficiencies that arise because water quality is degraded, i.e., other resources have to be purchased and substituted for water, because water quality is lower than optimal.

§ **Distribution:** Power users will have more disposable income than they would have if they paid the full social cost for power. Similarly, because water quality will remain degraded

(or in the alternative, its price will be higher than it should be), water users will be less well-off, and will be paying more for water-quality related products.

If a utility is deemed financially able to pay, Ecology then looks at demographic and financial data for the utility's customers. It is not clear from the Guidance how Ecology plans to use this data, but it appears that based on this information, Ecology is considering granting the *utility* relief from compliance. Such an approach would exhibit all the shortcomings listed here.

B. The Apparent Intent of the Proposed Procedure

Ecology is aware of all these outcomes and resource misallocations. They demonstrate throughout the Guidance a sophisticated understanding of economics.³ So why have they proposed such a procedure?

Ecology goes to some pains to explain that the feasibility test is not a benefit-cost analysis, not a test of whether the benefits of the WQS are worth the costs, whether the right standards have been promulgated. Rather, Ecology's concern is one of equity: easing the burden of environmental costs on dam operators with relatively high compliance costs; on unacceptably burdened customers (households and businesses); and on the regional economy.

Broad regulatory changes can be disruptive, and transitions are important to ease the period of adjustment. Unfortunately, the path that Ecology has chosen is ill-conceived, inefficient, and inequitable. There is no way to internalize environmental costs without those responsible for the externality being affected. Further, protection of the environment is not a secondary responsibility, and mitigation is not the last resource which a company has to purchase. Mitigation is just one of the resources necessary for a company to operate. No one is proposing relief for dam owners who find it difficult to pay for the cost of rewinding generators, replacing flood gates, hiring engineers, etc. If a company cannot cover the cost of all the inputs required for it to operate (market and non-market), in the long-run it probably should not be operating. Indeed, this is exactly Ecology's position in the text box on p. 5-9.

Importantly, both PUDs and investor owned utilities (IOUs) are going to attempt to pass on the costs of compliance with the WQS. PUDs, as non-regulated entities, generally have to obtain the approval of the PUD commissioners to include the costs in the ratebase. Ultimately, the PUD needs to cover the cost of service with revenues from the sale of electricity. If it does not, the PUD may find it difficult to raise capital. IOUs, as regulated entities, have to go through a rate case proceeding in order to be able to include the costs in ratebase. A rate case is an expensive proposition, and one does not embark on it lightly. Unless the compliance costs are substantial, there may be some delay before an IOU applies to the PUC for rate changes. Generally, an IOU will wait until it has enough accumulated expenses to warrant conducting a case. It cannot wait indefinitely, however, because in the interim it will be absorbing the compliance costs in one way or another: reduced retained earnings and/or dividends, postponed investments and maintenance projects, etc. If an IOU significantly reduces its dividends, it is likely to find it more difficult and more expensive to gain access to capital. For all the reasons cited in Section

³ See for example paragraph 2, p. 1-3 and the text box on p. 5-9.

I.A above, users of electricity should be confronted with the cost of serving them; this conclusion is independent of who is serving them, an IOU, a PUD, or a Federal agency.

To the extent that Ecology's feasibility test is intended to grant relief from the cost of implementing WQS to unacceptably burdened customers, there are preferable ways to achieve that goal, approaches that do not require foregoing attainment of water quality standards. A more appropriate approach is outlined below.

Preferable Approach: Is there a way to implement WQS while easing the burden on low income customers and minimizing inefficiencies (misallocations of resources)? Yes: through a public grant program with the grants based on financial status and unrelated to the recipient's consumption of power. Under such an arrangement the income effect of increases in the price of electricity is blunted for eligible customers. However, these customers are still confronted with the full cost of power, and make efficient decisions about the amount of power to purchase.

If Ecology's concern is financially stressed customers, its approach does not target them. Utilities across the spectrum of financial status and the socioeconomic characteristics of their customers have financially stressed customers. Ecology would only extend relief to a subset of them through its arbitrary eligibility standards. For example:

- § Consider a utility that does not trigger relief either under the financial feasibility test or under the socioeconomic test for the region it services. Ecology is not going to grant it relief, but, there are customers in its service region that are financially stressed. Why aren't they as deserving as financially stressed customers of utilities that are granted relief?
- § Consider a utility that does trigger the relief standards. All of its customers are going to receive relief from the mitigation costs whether or not they are financially stressed.

This is a completely inequitable, arbitrary process. It does not target all the financially stressed customers, and it does not target only the financially stressed customers.

A second-best solution would be to grant rate relief to needy utility customers, but this is clearly not an efficient solution. The grant is related to power consumption, and alters the price that eligible customers pay for electricity. Ecology recommends consideration of rate relief for low-income customers in section 5.6, p. 5-14. It does not seem to be recommending a publicly funded program, however, but rather rate relief extended by and funded by the utility. That is inappropriate unless the utility is reimbursed.

Ecology alludes to financial assistance to low-income households in section 8.1, p. 8-1. This one reference is hardly reassuring, however. The emphasis throughout is on relief from compliance.

II. Critique of the Proposed Financial Feasibility Factors

None of the following analysis should be taken as an endorsement of Ecology's proposed economic feasibility evaluations. As stated above, it does not make sense to use the results of a feasibility analysis (at the firm or regional economy level) to determine whether a dam owner – regardless of whether it is Federal, a PUD, or an IOU – should be relieved of some or all of its

water quality compliance responsibilities. The solution outlined above for addressing inequities (see “Preferable Approach”) is much more appropriate than an approach that limits the measures to be implemented to attain compliance with water quality standards. Again, that solution applies universally across ownership types.

A. Overarching Comments

1. Impacts of Rate Increases on Customers

Ecology has identified various factors/conditions to be evaluated when determining whether a PUD, investor owned utility, or Federal agency has the ability to pay for water quality measures necessary to attain water quality standards. These factors are set forth in Chapters 4, 5, and 6 respectively. Each chapter calls for the same evaluation of two factors that are of particular concern – household costs⁴ and costs on business customers.⁵ It is not at all clear how Ecology intends to use this information or what role it plays in a determination regarding a dam owner’s ability to pay for necessary water quality improvements. For example, in Section 4.2, Ecology states that the dam owner should evaluate the anticipated impact of the project costs on its customers. As part of that evaluation, “[i]f the project would affect households in more than one municipality, the applicant should conduct the analysis of both financial and socioeconomic impacts on a municipality by municipality basis once project costs are allocated to each jurisdiction served.”⁶ Ecology goes on to state further that “there is no existing guidance regarding increases in utility rates that are likely to represent *substantial financial impacts that would cause widespread social and economic impacts.*”⁷

Not only does Ecology request information related to impacts on households and business customers as part of the financial feasibility test for the dam owner, it also discusses rate impacts as part of socioeconomic impacts.

Including the analysis of the effect of rate increases on customers in the same chapter as the financial analysis of the dam owner, as Ecology does with the three types of owners, seems inappropriate and confusing. Projecting the effect of a rate increase on demand for electricity, revenues, and the dam owner’s financial status relates to the financial feasibility of a dam owner. However, the demographics of the customers and their ability to pay is not relevant to a determination of a dam owner’s ability to pay. That information is more appropriately considered as part of the socioeconomic analysis set forth in Chapter 7.

2. Estimation of Rate Increases

Ecology has proposed that dam owners estimate the increase in rates for power resulting from compliance with WQS. As already stated, it is unclear how Ecology plans to use this information. Should Ecology make clear how it intends to use the information – for example, as part of the larger socioeconomic test set forth in Chapter 7 or for a financial relief program for

⁴ Guidance Document, sections 4.2, 5.3, and 6.2.

⁵ Guidance Document, sections 4.3, 5.4, and 6.3.

⁶ Guidance Document, p. 4-3.

⁷ Guidance Document, p. 4-4 (emphasis added).

customers along the lines of that recommended above,⁸ those estimates in conjunction with demographic information would be useful in determining impacts and eligibility for relief. The following are some fundamental issues that should be addressed when estimating rate increases. These issues are not adequately captured in Ecology's proposed method for estimating rate increase.

The burden that mitigation costs represent for ratepayers is best reflected by the percentage increase in their electric bills, i.e., the percentage increase in the total revenue which they pay for power. (The percentage increase in customer electric bills is, of course, identical with the percentage increase in the average price users pay per kwh.) Estimating the percentage increase in rates involves many assumptions, and offers the opportunity for much mischief and the presentation of misleading results. A few of the issues involved are:

- § The total revenue base used in estimating the rate impact from mitigation costs should represent a typical year, including expected climatological conditions.
- § The appropriate time period over which the analysis should be conducted is the life of the mitigation project.
- § Changes (growth or shrinkage) in the customer base and the revenue base over the analytic time period should be reflected in the analysis.
- § How mitigation costs are allocated among customer classes (residential, commercial, industrial, agricultural, and wholesale) is a crucial part of the analysis. The responsibility for mitigation costs among users of power depends upon what activity causes the environmental damage. For example, if the damages to the riverine system occur when power (mwh) is produced and consumed, then the relative share of revenues paid for that power is unrelated to and not a good measure of those damages. The share of mwh consumed is the right measure.
- § One way to exaggerate the percentage increase in rates due to the cost of mitigation is to undervalue the denominator, the utility's revenues. IOUs often do this by inserting the regulatory base, the revenues authorized by the PUC in the last rate case. If the utility's customer base, the demand for its power, or the cost of resources other than those for environmental mitigation are growing, this regulatory base will be less than the total revenues paid by power users for electricity. Dividing this artificially small base into mitigation costs inflates the percentage increase in the cost of power to users stemming from the cost of mitigation.

These are just a few of the considerations to be mindful of when conducting an estimate of rate increases for any of the dam ownerships addressed in Ecology's Guidance Document. Appendix 1 to this document outlines a simplified procedure for regulated utilities (IOUs) for determining: i) the revenue requirements associated with environmental mitigation and ii) the effect that those revenue requirements have on ratepayers' power costs over the life of the mitigation project. This procedure differs from that recommended by Ecology in the Guidance. The procedure I recommend reflects the practices followed by public utility commissions in rate cases. In crafting a method for estimating rate increases, Ecology would do well to utilize these recommendations.

⁸ See section above entitled "Preferable Approach."

B. Chapter 4: Municipalities and Public Utility Districts

There are several problems with Ecology's proposed financial feasibility conditions for municipalities and PUDs, as set forth in Chapter 4. First, it goes without saying that the above discussion of the allocative efficiency aspects of Ecology's financial feasibility test are generally applicable; they apply to all dam owners, regardless of type of ownership. As such, it does not make sense to use the results of a feasibility analysis to determine whether a PUD should be relieved of some or all of its compliance responsibilities.

Second, as discussed in Section II.A above, Ecology requests that the dam owner provide information related to impacts on household and business customers. This information is not relevant to a dam owner's ability to pay except to the extent that it is related to changes in the demand for electricity, the utility's revenues, and the dam owner's financial status. This should be made clear.

Finally, in Exhibit 1, p. 2-4, Ecology summarizes the financial analysis to be conducted for the various types of dam owners. Ecology is proposing different standards for determining financial feasibility and eligibility for relief for PUDs than it is for investor owned utilities. The proposed test for PUDs is "[a]bility to finance controls, community financial health (e.g., bond rating, debt level, unemployment rate), and increase in user fees (e.g., electricity rates)." For IOUs Ecology identifies various factors to be considered when determining eligibility, including profitability, financial ratio analysis (liquidity, solvency, leverage), and increase in user fees. All of the factors identified as part of the assessment of an IOU's ability to pay are measures of various aspects of financial viability. I see no reason why the PUDs cannot be evaluated in exactly the same manner. Ecology should evaluate a PUD's ability to pay in accordance with the factors set forth in Chapter 5, excluding sections 5.3 and 5.4 which address household costs and costs to business customers.

As is apparent from the text box on p. 4-1, PUDs have authorities and access to revenues that IOUs do not. But a PUD maintains a budget, a balance sheet, and an income statement, and its access to capital in the private market is influenced by the evaluations of bond rating companies.⁹ It is true that PUDs have taxing authority, but one could evaluate the effect of compliance with WQS on a PUD's financial condition excluding exercising its taxing authority or resorting to issuance of general revenue bonds. Such an assessment is comparable to the ones Ecology has proposed for IOUs.

C. Chapter 5: Investor Owned Utilities

For completeness and at the risk of being repetitious, it makes no sense to use the results of a feasibility analysis to determine whether an IOU should be relieved of some or all of its compliance responsibilities.

⁹ Although PUDs are supposed to be nonprofits, they often are not. They retain funds for a variety of business purposes, just like an IOU.

Secondly, demographic information about a utility's customer base is irrelevant to a dam owner's financial health except as it influences the demand for power. Move sections 5.3 and 5.4 which address household costs and costs to business customers to a socioeconomic chapter.

D. Chapter 6: Federal Dams

As Ecology rightly points out, it does not make much sense to conduct a financial analysis on a Federal bureau that owns and operates a dam.¹⁰ Congress funds the bureaus, and during the budgetary process determines the funding of particular projects. Ecology asserts that a Federal dam owner/operator does not have to demonstrate that it cannot afford to pay for the WQS project. As such, it is not at all clear what Ecology is proposing with respect to federally owned dams, making it difficult to provide meaningful comment at this time.

Nonetheless, Ecology calls on the Federal dam owner/operator to estimate annual costs, evaluate impacts of rate increases on households, and evaluate impacts of rate increases on businesses. For reasons already stated, impacts on households and business customers are not relevant to a determination of whether a dam owner can pay for water quality improvement measures. Moreover, with regard to impacts of rate increases, it is important to recognize that the rates for power from Federal dams are almost never market determined. They are primarily a mix of social policy and budgetary considerations. Ecology seems intent on evaluating customers of Federal dams according to the same demographic paradigms it has chosen for customers of PUDs and IOUs. It seems an inappropriate application of the indicators.

III. Socioeconomic and Regional Analysis:

Ecology has proposed that the economic feasibility test include a second step – can the project be implemented without substantial socioeconomic disruption to the service region and any related geographic area? Conducting regional economic analysis can be a tricky business, however. Hamilton, et al., *Economic Impacts, Value Added, and Benefits in Regional Project Analysis*, American Journal of Agricultural Economics, 1991 is a comprehensive review of the difficulties associated with conducting regional economic impact analysis. If Ecology ultimately decides to rely on regional economic analysis as part of whatever program it adopts, I recommend Hamilton, et al. as a helpful reference. In particular, if Ecology decides to institute a financial relief program for customers along the lines of that recommended above in the “Preferable Approach” section, such analyses could prove useful in determining eligibility for relief. A detailed summary of their paper is outside the bounds of the current project, but I will cover a few key points:

The principal point is the same throughout: economic benefit/loss compared to what? That is, in the case of gains, what is the opportunity cost of the resources used to generate the new, local, economic activity? If the resources were unemployed or underemployed originally, then there is a gain, but in what region and over what time period? In assessing losses, one reverses the analytic process. Resources are unlikely to remain unemployed forever. How long is the transition period until they are reemployed? What is their new income level? Regional economic analysis is a fine art, and it takes considerable skill to know how to structure the

¹⁰ Guidance Document, p. 6-1, last full paragraph.

analysis, interpret the results, and count the gains and losses. Some examples, observations, and cautionary remarks applicable to regional analysis associated with the implementation of WQS:

- § Regions are subject to leakages or spill-over effects, and the smaller the region under consideration, the more likely it is to experience leakages. What appears as a gain or loss in one region can well result in an equal and opposite effect in a neighboring community. Suppose, for example, that as a result of increased electrical rate, resources are displaced in Region A in period 1, but in period 2 these resource are reemployed in Region B. If we conduct a socioeconomic analysis only of Region A, it looks like society has suffered a loss. But this apparent loss is an artifact of how we drew the boundaries for our regional analysis.
- § Suppose that water quality facilities are constructed in Region A. The resources used to construct the facility earn incomes, and it appears that income and employment in Region A increased. But suppose that the resources engaged in the construction were already fully employed in Region B and that they were induced to take jobs in Region A because of higher wages. Collectively, there has been no increase in employment, and the increase in incomes is only the difference between what the resources earned previously in Region B and what they earn now in Region A.
- § Regional economic analyses generally overlook non-market benefits. Utilities engaged in socioeconomic analyses to comply with Ecology's standards are not likely to stress the benefits associated with water quality improvements without considerable oversight by Ecology. Based on the draft Guidance, Ecology isn't emphasizing these benefits. There is almost no mention in chapter 7 of the potential regional economic benefits associated with improvements in water quality. Almost as an after thought Ecology cites changes in recreational amenities as one of the considerations to take into account in conducting the socioeconomic analysis.¹¹

One cannot conduct a legitimate regional economic analysis associated with water quality improvements if one looks only at the costs involved and ignores the benefits, or if one draws the regional boundaries narrowly. If water quality improvements are not beneficial, why is Ecology requiring them? And if the benefits accrue widely, but the costs are born narrowly and locally, is that a reason not to implement the WQS? It may be a reason to consider compensation, but if the benefits are worth the costs, it is not a reason to grant relief from compliance.¹²

IV. Additional Comments:

p. 4, section 4: Ecology addresses feasibility at the dam level, e.g., "...where the dam had the ability to finance a costly project..." and "...what is economically feasible for the dam..." Electricity is not sold at the dam level, and accounting is not conducted at the dam level. Power is sold and accounting is conducted at the firm or owner level. A dam is just one piece of equipment. Note that it is conceivable that after WQS are implemented, a dam will become unprofitable, because its costs (all its cost, not just the additional costs of mitigation) exceed its

¹¹ Guidance Document, p. 7-1, last full paragraph.

¹² Note that the logic at the macroeconomic level (the regional analysis) is identical with that at the microeconomic level (the feasibility analysis at the company level). The correct policy at both levels is that outlined in the section entitled "Preferable Approach."

revenues. Whether or not to operate such a dam is a decision for the owner to make, not a regulatory authority. There are situations in which owners find it economically preferable to operate an unprofitable dam due to the expense involved in decommissioning.

p. 5-4, 1st paragraph: The next to last sentence is incorrect. If taxes are levied by both the state and the federal government, one cannot find the overall marginal rate by adding the two rates together. The correct calculation is:

$$t = f + s - fs, \text{ where } \begin{array}{l} t = \text{combined marginal tax rate,} \\ s = \text{state marginal tax rate, and} \\ f = \text{federal marginal tax rate.} \end{array}$$

p. 4-6, Exhibit 2: Ecology does not provide a justification or source for the numeric thresholds.

Appendix 1: Procedure for Determining Revenue Requirement for Mitigation Costs and their Impact on Ratepayers

The purpose of this exercise is twofold: to determine i) the revenue requirements associated with environmental mitigation and ii) the effect that those revenue requirements have on ratepayers' power costs over the life of the mitigation project. In this document I delineate the procedures that I believe should be followed to calculate the mitigation costs, derive the revenue requirements based on these costs, and estimate the effect on ratepayers. These procedures reflect the procedures which public utility commissions follow in conducting rate cases.

1. SUMMARY OF APPROACH

Project Origin

For purposes of this exercise we need to designate an origin or initiation point, so that we can distinguish between past, present, and future expenditures. We shall designate the point of origin as the day that the project is first placed in the ratebase. Call it year 0.

Capital Costs

Capital expenditures are entered into the ratebase at the cost of construction or acquisition. None of the capital costs associated with an item enters the ratebase until the item is used and useful, i.e., is in operation and providing services.

Prior to entering the ratebase: Capitalizable expenditures which are incurred prior to being put in the ratebase are valued at their original cost or current dollar value. Costs incurred over a period of years are combined to obtain the total cost of the item. The costs are not to be converted to constant dollars.

After entering the ratebase: Capital expenditures which are expected to be incurred after the mitigation facilities originally enter the ratebase should be valued at year 0's prices. Thus, we do not speculate on future rates of inflation; all post-operational expenditures are to be evaluated at the prices in effect at the time of initial operation.

As indicated above, the principal purpose of this exercise is to determine the revenue requirements associated with mitigation. Any costs which are not mitigation-related must be netted out before proceeding.

O&M Costs

O&M costs should be the average of the sum of the annual O&M costs for the project over the lifetime of the facilities. Each year's O&M should be valued at year 0's prices.

Revenue Requirements

The cost elements involved in determining the revenue requirements for covering costs in a rate proceeding are: the return of and on capital, O&M, income taxes, and property taxes. Given the purpose at hand, however (estimating the effect that mitigation costs will have on the rates for power over the life of the mitigation project), a number of legitimate, alternative approaches could be taken to quantifying revenue requirements.

I summarize the approach which I favor below. The arithmetic details of estimating the revenue requirement are given below in the section 2 (A Simplified Procedure for Estimating Revenue Requirements Associated with Mitigation Costs).

Return of and on capital: Compute an annualized, levelized value for the return of capital and the return on capital together. I believe this is preferable to levelizing the return of capital (depreciation) and allowing the return on capital to fall annually. I believe that our suggested approach provides a more accurate measure of the expected, average impact of capital recovery and return on capital on revenue requirements over time.

I laid out the procedure for pricing individual capital elements and entering them into the stream of costs in the “Capital Cost” section above.

O&M: As explained above, O&M costs should be the average of the sum of the annual O&M costs for the project over life of the mitigation project. There is no return calculated on O&M costs; they simply flow through annually, dollar for dollar.

Income and property taxes: I outline an approach for estimating average income and property taxes in the section 2 below.

The approach summarized above involves calculating the principal streams of costs, annualizing or averaging them, as appropriate, and adding them up. This approach has the advantage of levelizing the mitigation costs and revenue requirements over the life of the facility.

Rate Impact

The burden that mitigation costs represents for ratepayers is best reflected by the percentage increase in their electric bills, i.e., the percentage increase in the total revenue which they pay for power. (The percentage increase in customer electric bills is, of course, identical with the percentage increase in the average price users pay per kwh.) The total revenue base used in estimating the rate impact from mitigation costs should represent a typical year, including expected climatological conditions.

2. A SIMPLIFIED PROCEDURE FOR ESTIMATING REVENUE REQUIREMENTS ASSOCIATED WITH MITIGATION COSTS

I am interested in the revenue required to cover the cost of specified mitigation. Full reimbursement for the cost of mitigation through power revenues requires us to take account of

four elements: the return of capital and O&M costs; the return on capital; income taxes on the return on capital; and property taxes on the newly capitalized costs. I begin with an estimated stream of costs associated with a mitigation proposal.

Annualizing/averaging costs: The initial step is to calculate the annualized (levelized) value equivalent to the estimated stream of costs. This stream of costs should reflect a typical year during the life of the mitigation project. As explained above in the body of the paper, the streams of capitalizable items must be separated and treated differently from those for O&M and taxes.

Let A be the annualized value for the capital stream, A' be the average value for the stream of O&M costs, and r be the discount rate. One option for the discount rate is the dam operator's weighted average cost of capital (WACC), but a rate approved by the governing PUC is also a legitimate value.

A includes both the *return on* and *the return of* capital. To decompose A into its two components, solve the following for K , the annualized return of capital:

$$A = K + rK$$

$$\text{Thus, } K = A/(1 + r).$$

$$\text{Further, the annualized return on capital is: } rK = A - K = rA/(1+r).$$

Property tax: To calculate the annual property taxes precisely, one would need to allocate the additions to the company's property among the counties served, apply the individual county property tax rates to the undepreciated value of the property, and then annualize over the life of the mitigation facility. This, although manageable, involves a significant amount of work, and may create the illusion of more precision than the calculations provide, especially since one has to make several assumptions: the period of depreciation, the method of depreciation, the period when property enters the tax rolls, and the relationship between assessed value and the cost of construction. In Washington tax rates for the relevant counties do not differ much, assessment is conducted at the State level, and the State assesses new utility property at the cost of construction. The following simplified approach to estimating the property tax on new mitigation capital would seem adequate:

- § Develop an average tax rate or a range for the tax rates.
- § Depreciate mitigation capital on a straight line basis over the life of the facility.
- § Assume that assessed value is identical with construction cost.

Assume that we know C_t , the capitalizable construction cost in year t . We can then develop the undepreciated (and hence taxable) value of the property in subsequent years. Apply the property tax rate to those values to develop the stream of property taxes. Averaging this stream over the life of the mitigation project gives P , the levelized property tax on newly constructed mitigation.

This last may well differ from the practices of taxing authorities and PUCs. However, for purposes of the current exercise, estimating the increase in revenue requirements over life of the mitigation project and averaging them seems a reasonable approximation.

Income taxes: To calculate the annual income taxes (T), let Y be taxable revenue, i.e., revenue after all allowable tax deductions. There is no need to know the structure of the Federal or State tax codes or what items are deductible from gross revenue in order to determine Y. Let

T = the tax revenue on Y

t = the marginal tax rate on Y. This tax rate accounts for both State and Federal tax rates.

Let the dam owner's capital structure consist of B (bonds) and E (outstanding stock). Then, the proportion in equity is: $e = E/(B+E)$. Only part of the return on capital, rK is the return on equity; the rest is bond interest. The total return on equity is $e(rK)$, and $e(rK)$ is net income after tax.

Thus, $Y = T + e(rK)$, i.e., taxable income equals taxes plus net income after taxes.

But net income = $(1-t)Y = (1-t)(T + e(rK)) = e(rK)$

Since T is the revenue required to cover State and Federal taxes, solve for T:

$$T = t(e(rK)) / (1-t)$$

All variables in this expression are known except t. To find t do the following:

Let $T' = F' + S'$ = the required revenue to cover State and Federal taxes on a marginal, taxable \$1, where

F' = the Federal tax on a marginal, taxable \$1 under the Federal code.

S' = the State tax on a marginal, taxable \$1 under the State code.

Let f = the Federal marginal tax rate, and

s = the State marginal tax rate.

Both s and f are known.

Assume that S' is determined first and that S' is deductible from income before applying f and determining F' . Thus,

$$S' = s(1), \text{ and}$$

$$F' = f(1 - S') = f - fs$$

Then $T' = F' + S' = s + f - fs$

But since T' is the combined tax on the marginal \$1, it is also the combined tax rate (t) on the marginal \$1. Thus, $t = s + f - sf$.

Further, reversing the sequence of determination and deductibility, i.e., F' is determined first and deducted before calculating S' , makes no difference. One gets the same value for t .

Annual revenue requirement (R): We now have a method for calculating all the components of the additional revenue requirement: O&M (A'), return of and on capital (A), income taxes (T), and property taxes (P). Thus,

$$R = A' + A + T + P$$